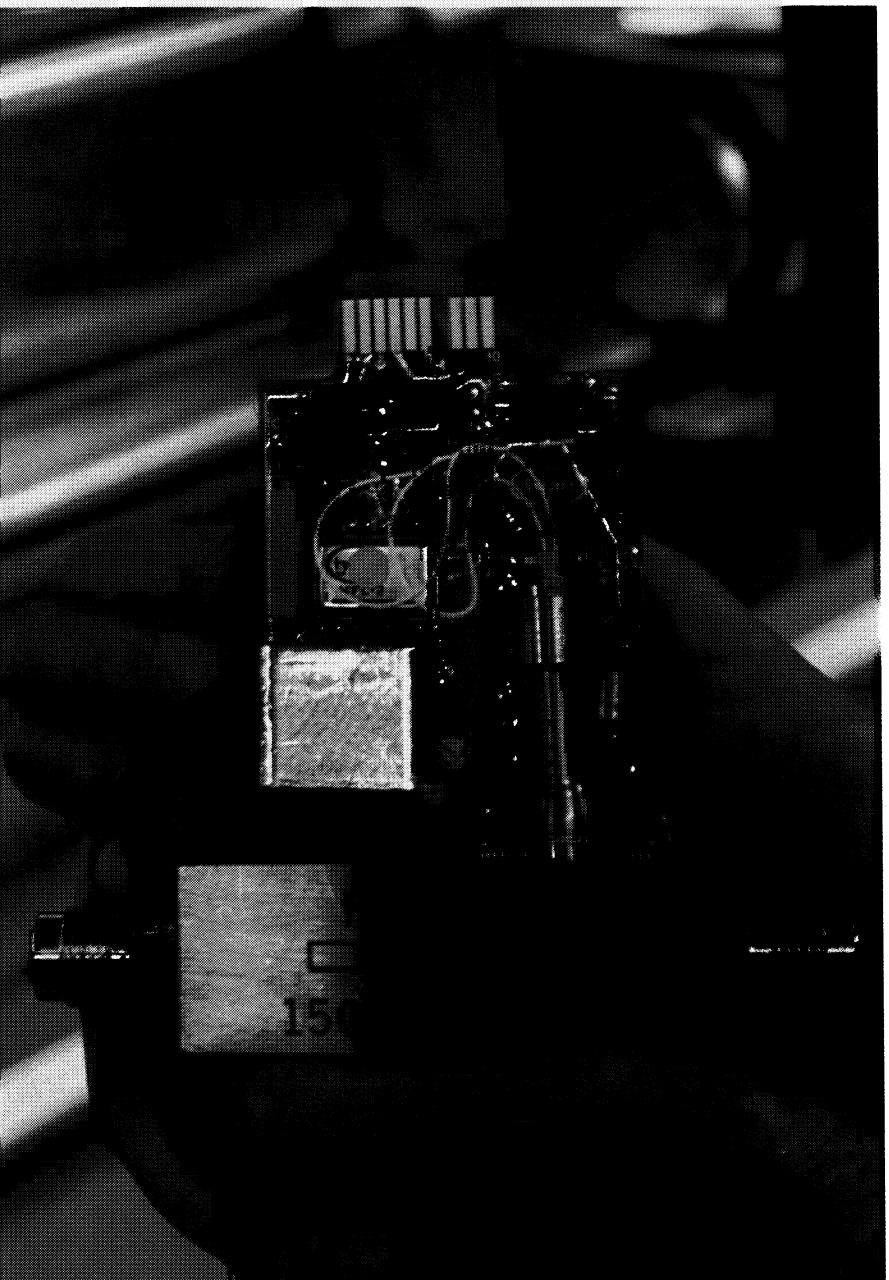
Gas Flow Controller

A critical item of equipment on Apollo spacecraft was a device used to measure the flow of oxygen in the spacecraft's life support system. Extremely accurate flow measurement was necessary to detect cabin leakage, to make sure that the oxygen supply was not consumed too rapidly, and to help the astronauts breathe normally. The measuring device, called the Mass Flowmeter, was developed by Tylan Corporation, Torrance, California.

The technology developed for the Apollo flowmeter provided a basis for a commercial product now widely used in the semiconductor industry, the Tylan Mass Flow Controller pictured below. Its major application is accurate control of reactive gases—such as hydrogen, phosphine and silane—as they are diffused at extremely high temperatures into silicon wafers. The wafers are ultimately cut up into integrated circuits, or "chips," for electronic products. The precise process control afforded by the Mass Flow Controller makes it possible to produce circuit chips of greater performance at lower cost.



Plasma Spray System

NASA's Lewis Research Center is conducting research on "thermal barrier" coatings designed to improve aircraft turbine engine efficiency and reduce fuel consumption. These coatings, applied to turbine blades, combustors and other engine parts, act as insulators to protect the parts from corrosion in the extremely hot environment. The protection thus afforded allows increasing the operating temperature of an engine by several hundred degrees, a means of increasing overall engine efficiency. The technology also has applicability to utility and industrial gas turbines, and a Lewis contractor—TRW Inc.'s Materials Technology, Cleveland, Ohio—has invented an important system for applying the coatings to either aircraft or non-aerospace turbines.

In the photo at right, the computer-aided, fully-automatic TRW system is spraying a very hot plasma onto a turbine blade. Composed of gas into which metallic and ceramic powders have been injected, the plasma forms a two-layer coating which insulates the blade. A critical part of the operation is controlling the thickness of the deposit, which is measured in thousandths of an inch. This is accomplished by an optical detector which illuminates spots at various locations on the blade and determines thicknesses by measuring the light reflections. The optical sensor monitors the spraying process until the precise coating thickness and thickness profile are attained, then the computer halts the spraying. NASA has granted TRW a waiver of title to the invention, allowing the company to market it commercially.